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COMPLETE ENSILED CORN RATIONS FOR LACTATING DAIRY COWS

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SUMMARY

Three experiments were conducted to compare corn silage mixed with the concentrate at time of ensiling with corn silage to which the concentrate was added at feeding time. One part of concentrate was mixed with seven parts of wet corn silage in each system, making the crude protein content of the total rations approximately 14.2%.

Cows fed the complete corn silage diet (concentrate added at time of ensiling) were more efficient in milk production as they consumed about 0.7 kg less dry matter per day, produced about 0.5 kg more 4% fat corrected milk (FCM), and declined 0.017 kg per day slower than when the concentrate was mixed with corn silage at feeding time.

The marked fall in milk production when changing from a 13.4% protein diet of one part concentrate, one part alfalfa hay, and one part corn silage on the as fed basis to the corn silage rations was eliminated by adding 2.27 kg of soybean meal per day to the experimental rations. This elevated the crude protein from 14.2% to 18.5%. It is yet to be determined whether the soybean meal, if added at time of ensiling, would have the same effect.

INTRODUCTION

Widespread interest in recent years in mechanized feeding of dairy cows prompted the authors to conduct a series of experiments beginning in 1969 on the performance of lactating cows fed complete ensiled rations.

In a previous experiment (4), Pratt and Conrad showed that dry matter intake and milk production were higher when ground ear corn was fed with high-moisture (24 to 32% dry matter) grass-legume silage than when high-moisture ear corn silage was used as the concentrate. The nitrogen (protein) from alfalfa hay also was utilized more completely than that from alfalfa silage. It was concluded that for highest dry matter intake and milk production, some unfermented grain or hay is needed to supplement high-moisture grass-legume silage. Of special interest in the experiments reported here was whether or not some unfermented feed would enhance dry matter intake and milk production when corn silage was fed.

Pardue *et al.* (3) found no difference in performance of cows fed a complete feed corn silage (grain added at ensiling) ration compared to grain added at feeding time using a 20.6% protein grain mixture as

40% of the total ration. Hooven *et al.* (2) compared a complete feed corn silage ration containing 40% grain mixture (27.9% protein) with corn silage fed free choice plus alfalfa hay at 0.5% body weight and the same grain mixture fed at 1 kg to 3 kg of milk produced as controls. In early lactation, the control cows ate more and produced more milk than the cows fed the complete feed silage. In late lactation, there was no difference in performance between the two rations.

EXPERIMENT 1—UREA IN CONCENTRATE

Methods

Beginning Sept. 2, 1969, two 10 x 40-foot silos were filled with corn silage, with alternate loads placed in each silo. In the experimental silo, 0.45 kg of mixed concentrate, D-186-68, was mixed with each 3.18 kg of wet chopped whole corn plant to make a complete feed silage. In the control silo, chopped whole corn plant was ensiled without any additional concentrate. The concentrate mix (D-186-68) contained 29.1% crude protein and consisted of ground shelled corn, 57.32%; soybean meal, 30.00%; dehydrated alfalfa meal (17% protein), 5.00%; urea, 3.52%; bone meal, 3.20%; and salt, 0.96%.

Beginning in January 1970, two balanced groups of six cows each, two Jerseys and four Holsteins, with average production of more than 25 kg per day during the preliminary period were selected. Both groups were fed for a 5-week preliminary period on a standard (1-1-1) ration consisting of one part by weight alfalfa hay, one part corn silage, and one part mixed concentrate (D-113, containing 21.9% crude protein) on the as fed basis. This ration contained approximately one-half concentrate on a dry matter basis, including the kernels in the corn silage, and was approximately 13.4% protein.

At the end of the preliminary period, both groups were abruptly switched to the corn silage rations for a 2-week transition (adjustment) period followed by an 11-week experimental period. Group I was fed free choice the complete ensiled ration from the experimental silo. Group II was fed the corn silage from the control silo with the same concentrate mixture (D-186-68) used in the complete ensiled ration, mixed with the silage at feeding time (two times daily) at the rate of 0.45 kg per 3.18 kg of wet silage. The mixture was fed in excess of the amount the cows would eat daily so that both groups were fed *ad libitum*. The mean crude protein equivalent of the complete ensiled ration (Group I) was 14.3% and that of the silage and grain mixed at feeding time (Group II) was 14.1%.

Criteria used in measuring the possible differences in the two feeding systems were milk production during the declining phase of lacta-

tion, both actual and 4% FCM, rate of decline in 4% FCM yield, milk fat, dry matter intake (DMI), digestible dry matter intake (DDM), and body weight changes. Kilograms 4% FCM per kilograms DMI and kilograms 4% FCM per kilograms DDM also were calculated as indicators of feed efficiency for milk production.

Results and Discussion

During the preliminary period while the 1-1-1 ration was being fed, 4% FCM production declined only slightly (Table 1 and Fig. 1). Both groups declined sharply in milk production (Group I, 0.257 kg/day; Group II, 0.186 kg/day, Table 4) during the 2-week transition (adjustment) period after being switched to the control and experimental rations. This was attributed at least in part to the time required for adjustment to the urea (NPN) in the ration. After the transition period, Group II declined at a rather slow rate, equal to 0.055 kg/day (0.30%/day) during the 11-week experimental period (Table 4). Group I, while declining more rapidly than Group II in milk yield during the transition period, continued to decline at a steady but significantly slower rate than the control cows, 0.033 kg/day (0.17%/day) during the 11-week experimental period. Thus, milk production after the initial transitional drop was more persistent in Group I than in Group II. No marked changes in percent milk fat were noted beyond the normal rise as lactation progressed.

Dry matter intake in Group I declined sharply during the transition period (Table 1 and Fig. 2), mostly during the first week. The decline in DMI was reflected in milk yield during the transition period. Throughout the experimental period, Group II maintained a higher level of DMI than Group I (Fig. 2 and Table 1), but milk yield was lower. Digestible dry matter (Table 1) was similar in both groups; the percent dry matter digestibility of Group I was higher, 79.1% compared to 76.7% for Group II. It is of interest that the digestibility of the 1-1-1 ration fed during the preliminary period was only 69.3%, yet DMI was higher and digestible dry matter was about the same.

All of these rations were above the level of digestibility where rate of digestion limits intake (1). Thus the intake in this experiment was inversely related to ration digestibility. The cows fed the complete ensiled ration (Group I) had a high feed efficiency for milk production during the experimental period, as they gave more milk from less feed dry matter and less digestible dry matter (Table 1 and Fig. 2).

The cows in Group I increased 15 kg in body weight during the combined transition and experimental periods (Table 1). Those in Group II gained an average of 36 kg (Table 1).

TABLE 1.—Changes in Milk Production and Composition, Body Weight, and Feed Intake, Digestibility, and Efficiency for Milk Production During Experiment 1.

	Preliminary Period						Transition Period	
Week	5	4	3	2	1	0	1	2
Group I (Complete Feed Silage)								
Actual milk, kg/d	26.0	26.3	26.4	25.3	25.0	24.7	22.1	20.7
4% FCM, kg/d	22.8	23.4	24.0	23.3	23.3	23.5	21.2	19.9
4% FCM/kg $BW^{0.75}$, kg/d	0.21	0.22	0.22	0.22	0.22	0.22	0.19	0.18
Milk fat, kg/d	0.82	0.86	0.90	0.88	0.87	0.90	0.83	0.78
Milk fat, %	3.3	3.3	3.5	3.5	3.5	4.0	4.0	4.1
Milk protein, kg/d								
Milk protein, %								
DMI, kg/d	18.7	19.1	19.0	18.9	20.0	20.0	16.0	16.3
DDM, kg/d	13.0	13.3	13.3	13.2	13.8	13.8	12.6	12.9
DM digested, %	69.5	69.6	70.0	69.8	69.0	69.0	78.7	79.0
Body weight, kg	510			512			521	
4% FCM/kg DMI, kg	1.22	1.23	1.26	1.23	1.17	1.18	1.33	1.22
4% FCM/kg DDM, kg	1.75	1.76	1.80	1.77	1.69	1.70	1.68	1.54
Group II (Concentrate Added at Feeding Time)								
Actual milk, kg/d	25.2	25.6	25.4	24.9	25.5	24.7	23.6	22.4
4% FCM, kg/d	23.8	24.1	24.4	23.6	24.5	23.9	22.6	21.3
4% FCM/kg $BW^{0.75}$, kg/d	0.21	0.21	0.22	0.21	0.22	0.21	0.20	0.19
Milk fat, kg/d	0.91	0.92	0.95	0.91	0.95	0.93	0.86	0.82
Milk fat, %	3.9	3.9	3.9	3.6	3.6	4.0	4.0	4.1
Milk protein, kg/d								
Milk protein, %								
DMI, kg/d	18.5	18.9	19.1	19.0	19.3	19.3	17.9	17.9
DDM, kg/d	12.7	13.1	13.2	13.2	13.3	13.3	13.7	13.7
DM digested, %	68.6	69.3	69.1	69.5	68.9	68.9	76.2	76.7
Body weight, kg	543			547			551	
4% FCM/kg DMI, kg	1.29	1.28	1.28	1.24	1.27	1.24	1.26	1.19
4% FCM/kg DDM, kg	1.87	1.84	1.85	1.79	1.84	1.80	1.65	1.56

TABLE 1 (Continued).—Changes in Milk Production and Composition, Body Weight, and Feed Intake, Digestibility, and Efficiency for Milk Production During Experiment 1.

	Experimental											
Week	3	4	5	6	7	8	9	10	11	12	13	Av.
Group I (Complete Feed Silage)												
Actual milk, kg/d	20.5	20.6	20.0	19.5	19.6	19.1	18.4	18.8	17.6	17.6	17.2	19.0
4% FCM, kg/d	19.4	19.5	19.3	18.8	19.0	19.7	18.6	18.7	17.7	17.4	17.0	18.7
4% FCM/kg $BW^{0.75}$, kg/d	0.18	0.18	0.17	0.17	0.17	0.18	0.17	0.17	0.16	0.16	0.15	0.17
Milk fat, kg/d	0.74	0.76	0.76	0.74	0.75	0.80	0.75	0.75	0.71	0.69	0.67	0.74
Milk fat, %	4.1	4.1	4.1	4.1	4.1	4.5	4.5	4.3	4.3	4.3	4.3	4.3
Milk protein, kg/d												
Milk protein, %												
DMI, kg/d	16.7	17.3	17.3	17.2	16.8	16.8	16.3	15.8	15.2	15.3	14.9	16.3
DDM, kg/d	13.2	13.7	13.7	13.6	13.3	13.3	12.9	12.5	12.0	12.1	11.8	12.9
DM digested, %	79.0	79.2	79.2	79.1	79.2	19.2	79.1	79.1	78.9	79.1	79.2	79.1
Body weight, kg			531				535				534	533
4% FCM/kg DMI, kg	1.16	1.13	1.12	1.09	1.13	1.17	1.14	1.18	1.16	1.14	1.14	1.14
4% FCM/kg DDM, kg	1.47	1.42	1.41	1.38	1.43	1.48	1.44	1.50	1.48	1.44	1.44	1.45
Group II (Concentrate Added at Feeding Time)												
Actual milk, kg/d	21.4	20.9	20.5	19.6	19.6	19.8	18.4	17.7	16.9	16.5	15.9	18.8
4% FCM, kg/d	20.3	19.8	19.6	18.2	18.3	18.6	17.8	17.8	17.0	17.2	16.6	18.3
4% FCM/kg $BW^{0.75}$, kg/d	0.18	0.18	0.17	0.16	0.16	0.16	0.15	0.15	0.15	0.15	0.14	0.16
Milk fat, kg/d	0.78	0.77	0.76	0.69	0.69	0.74	0.73	0.72	0.68	0.71	0.68	0.72
Milk fat, %	4.1	4.1	4.1	3.8	3.8	4.1	4.1	4.2	4.2	4.5	4.5	4.1
Milk protein, kg/d												
Milk protein, %												
DMI, kg/d	17.4	18.1	18.5	18.3	18.4	18.8	18.1	18.3	17.3	18.0	17.7	18.1
DDM, kg/d	13.3	13.8	14.2	14.0	14.1	14.4	13.9	14.0	13.2	13.8	13.6	13.9
DM digested, %	76.6	76.4	76.9	76.6	76.8	76.7	76.9	76.6	76.4	76.8	77.0	76.7
Body weight, kg			563				570				587	573
4% FCM/kg DMI, kg	1.17	1.10	1.06	0.99	1.00	0.99	0.98	0.97	0.98	0.95	0.94	1.01
4% FCM/kg DDM, kg	1.53	1.44	1.38	1.30	1.30	1.29	1.28	1.27	1.29	1.25	1.22	1.32

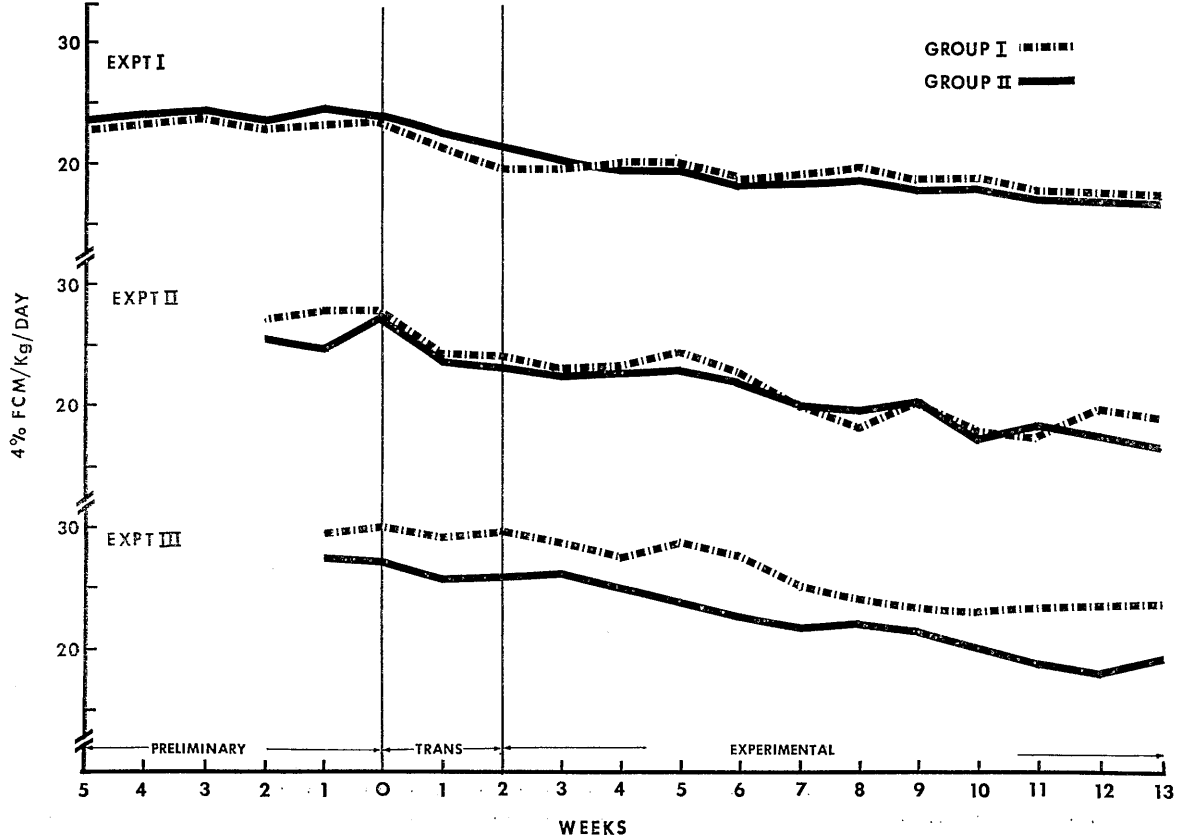

FIG. 1.—Changes in 4% FCM in Experiments 1, 2, and 3. Group I—complete feed silage. Group II—concentrate added to silage at feeding time, twice daily.

EXPERIMENT 2—NO UREA IN CONCENTRATE

Methods

In early September 1969, about the same time that the corn used in Experiment 1 was ensiled, two 8 x 30-foot silos were filled with alternate loads from the same field. In the experimental silo, 0.45 kg of concentrate (D-195-69) was mixed with each 3.18 kg of wet chopped whole corn plant at filling time. In contrast to the concentrate used in Experiment 1, D-195-69 contained no urea. It consisted of ground shelled corn, 40.8%; soybean meal, 50.0%; dehydrated alfalfa, 5.0%; bone meal, 3.2%; and salt, 1.0%. The total protein content of the concentrate was 27.5%. The control silo was filled with chopped whole corn plant with no added concentrate.

Two balanced groups of five cows, one Jersey and four Holsteins producing an average of 28 kg of milk per day, were selected. During the 2-week preliminary period, both groups were fed the 1-1-1 ration described in Experiment 1. Feed intake records were not kept during the preliminary period. Beginning May 25, 1970, Group I was fed the complete ensiled ration *ad libitum* from the experimental silo through a 2-week transition period followed by an 11-week experimental period. Group II was fed the corn silage from the control silo, with 0.45 kg of concentrate (D-195-69) mixed with each 3.18 kg of wet silage at feeding time. This mixture was fed in excess of the amount the cows would eat so that this group also was fed *ad libitum*.

The mean crude protein content of both the complete ensiled ration fed to Group I and the silage and concentrate mixture fed Group II was estimated to be 14%.

Criteria used to measure the differences in the two rations were milk production, both actual and 4% FCM, rate of decline in milk yield, milk fat, milk protein, DMI, DDM, body weight changes and kilograms 4% FCM per kilograms DMI, and kilograms 4% FCM per kilograms DDM calculated as indicators of feed efficiency for milk production.

Results and Discussion

Milk production (4% FCM) (Table 2 and Fig. 1) dropped sharply in both groups during the 2-week transition period (Group I, 0.264 kg/day, and Group II, 0.321 kg/day). During the experimental period, Group I declined at 0.085 kg/day and Group II declined at the rate of 0.101 kg/day (Table 4). This was a more rapid rate of decline in both groups than was observed in Experiment 1 where urea was added to the concentrate. Again, as in Experiment 1, the inability of both corn silage rations to maintain the level of milk production of the 1-1-1 ration

TABLE 2.—Changes in Milk Production and Composition, Body Weight, and Feed Intake, Digestibility, and Efficiency for Milk Production During Experiment 2.

	Preliminary Period						Transition Period	
Week	5	4	3	2	1	0	1	2
Group I (Complete Feed Silage)								
Actual milk, kg/d				28.5	29.3	29.8	25.8	26.4
4% FCM, kg/d				27.2	27.9	27.7	24.1	24.0
4% FCM/kg $BW^{0.75}$, kg/d				0.24	0.25	0.25	0.22	0.24
Milk fat, kg/d				1.06	1.08	1.06	0.92	0.90
Milk fat, %				3.8	3.8	3.6	3.6	3.4
Milk protein, kg/d				0.95	0.97	0.99	0.85	0.89
Milk protein, %				3.4	3.4	3.4	3.4	3.4
DMI, kg/d							14.9	15.4
DDM, kg/d							11.0	11.3
DM digested, %							73.8	73.4
Body weight, kg					562			574
4% FCM/kg DMI, kg							1.62	1.56
4% FCM/kg DDM, kg							2.19	2.12
Group II (Concentrate Added at Feeding Time)								
Actual milk, kg/d				27.5	26.7	28.4	25.9	25.7
4% FCM, kg/d				25.4	24.6	27.7	23.7	23.2
4% FCM/kg $BW^{0.75}$, kg/d				0.21	0.20	0.19	0.19	0.21
Milk fat, kg/d				0.96	0.93	1.02	0.89	0.86
Milk fat, %				3.7	3.7	3.6	3.6	3.3
Milk protein, kg/d				0.91	0.86	0.86	0.94	0.97
Milk protein, %				3.4	3.4	3.4	3.8	3.8
DMI, kg/d							15.3	17.0
DDM, kg/d							11.2	12.4
DM digested, %							73.2	72.9
Body weight, kg					611			624
4% FCM/kg DMI, kg							1.55	1.36
4% FCM/kg DDM, kg							2.12	1.87

TABLE 2 (Continued).—Changes in Milk Production and Composition, Body Weight, and Feed Intake, Digestibility, and Efficiency for Milk Production During Experiment 2.

	Experimental											
Week	3	4	5	6	7	8	9	10	11	12	13	Av.
Group I (Complete Feed Silage)												
Actual milk, kg/d	25.8	25.1	26.0	23.4	21.8	20.1	22.4	19.4	19.6	20.1	19.5	22.1
4% FCM, kg/d	23.0	23.0	24.3	22.5	19.9	18.2	20.0	17.6	17.5	19.3	18.9	20.4
4% FCM/kg $BW^{0.75}$, kg/d	0.23	0.23	0.24	0.21	0.18	0.18	0.18	0.16	0.15	0.17	0.17	0.19
Milk fat, kg/d	0.83	0.87	0.93	0.84	0.73	0.68	0.74	0.65	0.65	0.73	0.75	0.76
Milk fat, %	3.3	3.5	3.7	3.6	3.5	3.6	3.5	3.6	3.3	3.6	4.1	3.6
Milk protein, kg/d	0.87	0.84	0.87	0.73	0.68	0.63	0.70	0.63	0.70	0.73	0.70	0.73
Milk protein, %	3.4	3.4	3.4	3.1	3.1	3.1	3.1	3.3	3.6	3.6	3.6	3.3
DMI, kg/d	15.1	14.8	16.0	15.7	15.5	15.4	16.3	15.6	15.4	15.6	15.8	15.6
DDM, kg/d	11.1	10.7	11.7	11.6	11.4	11.3	12.0	11.7	11.5	11.7	11.9	10.5
DM digested, %	73.5	72.3	73.1	73.9	73.5	73.4	73.6	75.0	74.7	75.0	75.3	73.9
Body weight, kg				573				583			587	580
4% FCM/kg DMI, kg	1.52	1.55	1.52	1.43	1.28	1.18	1.23	1.13	1.20	1.24	1.20	1.32
4% FCM/kg DDM, kg	2.07	2.15	2.08	1.94	1.75	1.61	1.67	1.50	1.52	1.65	1.59	1.78
Group II (Concentrate Added at Feeding Time)												
Actual milk, kg/d	25.7	25.2	24.9	24.5	22.9	23.3	22.7	19.7	20.5	19.8	18.0	22.5
4% FCM, kg/d	22.6	22.8	22.9	21.9	19.8	19.4	20.1	17.3	18.0	17.5	16.5	19.9
4% FCM/kg $BW^{0.75}$, kg/d	0.20	0.21	0.21	0.18	0.15	0.16	0.15	0.14	0.14	0.14	0.13	0.16
Milk fat, kg/d	0.82	0.85	0.86	0.81	0.71	0.74	0.73	0.63	0.66	0.64	0.62	0.73
Milk fat, %	3.2	3.4	3.9	3.5	3.2	3.2	3.3	3.3	3.2	3.3	3.5	3.4
Milk protein, kg/d	0.95	0.93	0.92	0.80	0.73	0.75	0.73	0.65	0.70	0.69	0.65	0.77
Milk protein, %	3.8	3.8	3.8	3.3	3.2	3.2	3.2	3.3	3.5	3.5	3.5	3.5
DMI, kg/d	17.3	17.2	17.1	18.0	17.6	17.7	17.4	17.4	16.8	15.9	15.4	17.1
DDM, kg/d	12.7	12.5	12.5	13.1	12.9	12.9	12.7	12.7	12.2	11.7	11.3	12.5
DM digested, %	73.4	72.7	73.1	72.8	73.3	72.9	73.0	73.0	72.6	73.6	73.4	73.1
Body weight, kg				641				649			640	643
4% FCM/kg DMI, kg	1.31	1.33	1.34	1.22	1.13	1.10	1.16	0.99	1.07	1.10	1.07	1.17
4% FCM/kg DDM, kg	1.78	1.82	1.83	1.67	1.54	1.50	1.58	1.36	1.48	1.50	1.46	1.59

was demonstrated. There were no major differences between the groups in percent milk fat or protein (Table 2).

In the experimental period, both DMI (Table 2 and Fig. 2) and DDM (Table 2) were lower in Group I fed the complete ensiled ration than in Group II where the concentrate was added at feeding time. Mean dry matter digestibility for Group I was 73.9% and for Group II 73.1%, suggesting that some factor other than ration digestibility was responsible for the lower dry matter intake in Group I.

As in Experiment 1, the cows in Group I produced more efficiently than the cows in Group II, as indicated by 4% FCM/kg DMI and 4% FCM/kg DDM (Table 2).

Body weight increased in both groups. Group I gained an average of 25 kg during the combined transition and experimental periods compared to 29 kg for Group II.

EXPERIMENT 3—SOYBEAN MEAL ADDED

Methods

At the conclusion of the feeding trial described in Experiment 1 in May 1970, the two silos were capped and held until April 1971, when this experiment was begun. Two balanced groups of five cows, three Holsteins and two Jerseys, were fed the standard 1-1-1 ration in a 2-week preliminary period during which they produced about 26.5 kg/day. Beginning on April 16, 1971, Group I was fed the complete feed corn silage free choice from the experimental silo plus 1.14 kg of soybean meal (50% protein) added two times daily (total 2.27 kg/day) at feeding time. Group II was fed the corn silage from the control silo with concentrate D-186-68 mixed with the silage at feeding time at the rate of 0.45 kg per 3.18 kg of wet corn silage. The mixture of silage and concentrate was fed *ad libitum* two times daily. An additional 1.14 kg of soybean meal (50% protein) was added two times daily (total 2.27 kg/day) at feeding time. This was done to determine if the fall in milk yield, observed in Experiments 1 and 2 when the ration was changed from the 1-1-1 ration to the corn silage rations, could be avoided by the additional protein. The experiment covered a 2-week transition period for adjustment followed by an 11-week experimental period.

Criteria used to measure possible differences in the two feeding systems were: both actual and 4% FCM production, rate of decline in milk yield, milk fat, milk protein, DMI, and changes in body weight. Kilograms 4% FCM per kilograms DMI and kilograms 4% FCM per kilograms DDM also were calculated to indicate feed efficiency for milk production.

Results and Discussion

In contrast to Experiments 1 and 2, the decline observed during the transition period when the groups were switched from the 1-1-1 preliminary ration to either of the corn silage rations was small (Group I only 0.029 kg/day, Group II 0.093 kg/day). This indicated that the added soybean meal corrected the apparent protein deficiency which was largely responsible for the decline during the transition period in Experiments 1 and 2. The added soybean meal increased the percent protein in the rations from 14.2 to 18.5.

Rate of decline in 4% FCM was similar in both groups during the experimental feeding period (Group I, 0.091 kg/day, and Group II, 0.106 kg/day) (Table 4).

As shown in Table 3, the consistently higher percent milk fat and percent protein in Group I was reflected in the total milk fat and protein produced.

During the experimental period, both DMI and DDM were higher in Group I than in Group II despite the higher digestibility of the experimental ration (79.0%) compared to the control (75.6%). This is in contrast to Experiments 1 and 2, where no additional soybean meal was added (Table 3 and Fig. 2).

During the 11-week experimental period, there were no marked differences in efficiency of feed utilization for milk production as measured by kilograms FCM per kilograms DMI or kilograms FCM per kilograms DDM (Table 3). This was in contrast to Experiments 1 and 2, where the cows fed the complete feed silage tended to be more efficient than the cows fed their concentrate at feeding time.

EXPERIMENTS 1, 2, and 3—GENERAL DISCUSSION

The addition of 2.27 kg of soybean meal per day which raised the total protein in the dry ration from about 14.2% (Experiment 1) and 14.0% (Experiment 2) to 18.5% (Experiment 3) eliminated the marked drop in 4% FCM production observed in Experiments 1 (3.65 kg/day) and 2 (3.55 kg/day) during the 2-week transition period (Tables 1, 2, and 3 and Fig. 1). Average daily DMI and 4% FCM production plus daily rates of decline in 4% FCM during the 11-week experimental period for all three experiments are shown in Table 4.

Average DMI of all three experiments was significantly higher (0.7 kg/day) during the 11-week experimental period in Group II than in Group I. Average 4% FCM, however, was significantly lower (1.5 kg/day) in Group II than in Group I for all three experiments. Even after correction for initial intake and production level, these differences remained statistically significant ($P<.01$). The average rate of de-

TABLE 3.—Changes in Milk Production and Composition, Body Weight, and Feed Intake, Digestibility, and Efficiency for Milk Production During Experiment 3.

	Preliminary Period						Transition Period	
Week	5	4	3	2	1	0	1	2
Group I (Complete Feed Silage)								
Actual milk, kg/d					27.1	27.3	26.1	26.7
4 % FCM, kg/d					29.7	30.1	29.0	29.7
4 % FCM/kg $BW^{0.75}$, kg/d					0.26	0.26	0.26	0.26
Milk fat, kg/d					1.26	1.28	1.24	1.27
Milk fat, %					4.7	4.7	4.8	4.8
Milk protein, kg/d					0.83	0.83	0.80	0.81
Milk protein, %					3.1	3.1	3.1	3.1
DMI, kg/d					17.6	16.2	14.8	16.1
DDM, kg/d					12.2	11.2	11.7	12.7
DM digested, %					69.3	69.1	79.1	78.9
Body weight, kg							556	
4 % FCM/kg DMI, kg					1.68	1.86	1.96	1.84
4 % FCM/kg DDM, kg					2.44	2.69	2.47	2.33
Group II (Concentrate Added at Feeding Time)								
Actual milk, kg/d					26.2	26.4	25.5	25.6
4 % FCM, kg/d					27.4	27.2	25.8	25.9
4 % FCM/kg $BW^{0.75}$, kg/d					0.24	0.24	0.23	0.23
Milk fat, kg/d					1.13	1.11	1.04	1.04
Milk fat, %					4.5	4.3	4.2	4.2
Milk protein, kg/d					0.81	0.82	0.79	0.79
Milk protein, %					3.1	3.1	3.1	3.1
DMI, kg/d					19.1	17.6	15.9	16.5
DDM, kg/d					13.4	12.6	12.2	12.6
DM digested, %					70.2	71.6	76.7	76.4
Body weight, kg							547	
4 % FCM/kg DMI, kg					1.43	1.54	1.74	1.57
4 % FCM/kg DDM, kg					2.04	2.17	2.11	2.05

TABLE 3 (Continued).—Changes in Milk Production and Composition, Body Weight, and Feed Intake, Digestibility, and Efficiency for Milk Production During Experiment 3.

	Experimental											
Week	3	4	5	6	7	8	9	10	11	12	13	Av.
Group I (Complete Feed Silage)												
Actual milk, kg/d	26.4	25.1	26.1	25.0	23.5	24.4	23.6	22.6	22.5	22.6	22.7	19.5
4% FCM, kg/d	28.7	27.3	28.6	27.7	24.9	24.3	23.5	22.9	23.2	23.6	23.7	25.3
4% FCM/kg $BW^{0.75}$, kg/d	0.25	0.24	0.25	0.24	0.22	0.21	0.20	0.20	0.20	0.20	0.20	0.22
Milk fat, kg/d	1.21	1.15	1.21	1.18	1.04	0.97	0.94	0.93	0.95	0.97	0.98	1.05
Milk fat, %	4.8	4.8	4.9	4.9	4.7	4.4	4.4	4.5	4.6	4.7	4.7	4.7
Milk protein, kg/d	0.82	0.78	0.81	0.78	0.74	0.77	0.74	0.71	0.70	0.69	0.70	0.75
Milk protein, %	3.2	3.2	3.2	3.2	3.3	3.3	3.3	3.3	3.3	3.2	3.2	3.3
DMI, kg/d	16.6	16.9	17.0	16.5	16.0	16.2	16.5	15.5	16.1	17.0	17.4	16.5
DDM, kg/d	13.1	13.4	13.5	13.0	12.6	12.8	13.0	12.3	12.7	13.4	13.7	12.0
DM digested, %	78.9	79.3	79.4	78.8	78.8	79.0	78.8	79.4	78.9	78.8	78.7	79.0
Body weight, kg			572				576				579	576
4% FCM/kg DMI, kg	1.73	1.61	1.68	1.69	1.56	1.50	1.42	1.48	1.45	1.39	1.37	1.51
4% FCM/kg DDM, kg	2.19	2.04	2.13	2.13	1.97	1.90	1.80	1.87	1.84	1.75	1.73	1.94
Group II (Concentrate Added at Feeding Time)												
Actual milk, kg/d	25.6	24.2	24.2	23.5	22.1	21.9	21.3	20.1	19.1	18.5	19.4	21.8
4% FCM, kg/d	26.2	24.8	24.0	22.6	21.6	22.1	21.4	19.9	18.8	18.2	19.2	21.7
4% FCM/kg $BW^{0.75}$, kg/d	0.23	0.22	0.21	0.20	0.19	0.20	0.19	0.17	0.16	0.16	0.17	0.19
Milk fat, kg/d	1.07	1.01	0.96	0.88	0.86	0.89	0.86	0.79	0.74	0.72	0.76	0.70
Milk fat, %	4.3	4.3	4.1	3.9	4.0	4.2	4.2	4.1	4.1	4.1	4.1	4.1
Milk protein, kg/d	0.77	0.72	0.72	0.71	0.68	0.70	0.68	0.64	0.61	0.58	0.61	0.67
Milk protein, %	3.0	3.0	3.0	3.0	3.1	3.2	3.2	3.2	3.2	3.2	3.2	3.1
DMI, kg/d	16.6	15.9	16.0	16.0	15.1	14.8	15.2	14.2	14.1	13.7	14.9	15.1
DDM, kg/d	12.7	12.1	12.2	12.2	11.4	11.0	11.3	10.6	10.5	10.5	11.4	11.4
DM digested, %	76.5	76.1	76.3	76.3	75.5	74.3	74.3	74.6	74.5	76.6	76.5	75.6
Body weight, kg			550				553				546	550
4% FCM/kg DMI, kg	1.58	1.56	1.50	1.42	1.43	1.49	1.41	1.40	1.33	1.33	1.29	1.43
4% FCM/kg DDM, kg	2.06	2.04	1.96	1.85	1.90	2.08	1.89	1.88	1.78	1.74	1.68	1.90

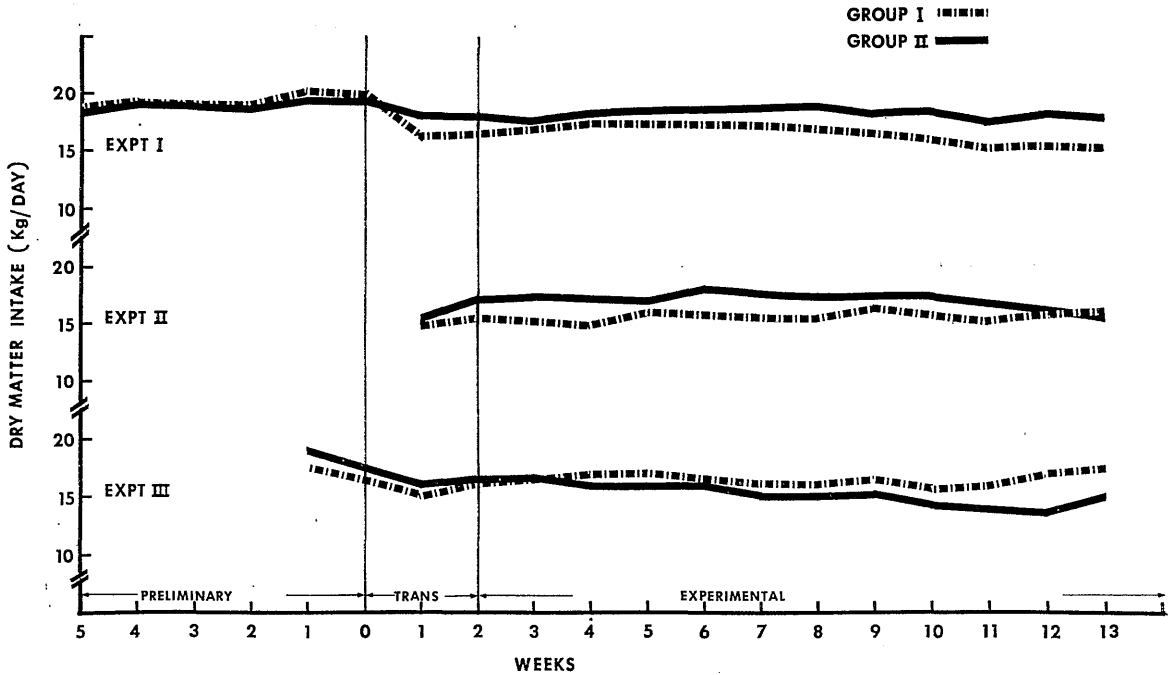

FIG. 2.—Changes in dry matter intake in Experiments 1, 2, and 3. Group I—complete feed silage. Group II—concentrate added to silage at feeding time, twice daily.

TABLE 4.—Average Daily DMI, 4% FCM, and Rate of Decline in 4% FCM During the 11-Week Experimental Period.

	Group I*				Group II†			
	Av. DMI	Av. 4% FCM	Av. Decline		Av. DMI	Av. 4% FCM	Av. Decline	
	kg/d‡	kg/d‡	kg/d‡	%/d	kg/d‡	kg/d‡	kg/d‡	%/d
Experiment 1	16.3[a]	18.7[a]	0.033[a]	0.17	18.1[b]	18.3[a]	0.055[b]	0.30
Experiment 2	15.6[a]	20.4[a]	0.085[a]	0.41	17.1[b]	19.9[a]	0.101[a]	0.50
Experiment 3	16.5[a]	25.3[a]	0.091[a]	0.35	15.1[b]	21.7[b]	0.106[a]	0.48
Average	16.1**	21.5**	0.070[a]	0.31	16.8**	20.0**	0.087[b]	0.43

*Group I—complete feed silage.

†Group II—concentrate added at feeding time.

‡Least significant differences (LSD) for DMI in Experiments 1, 2, and 3, respectively, were: 0.186, 0.179, and 0.116; for 4% FCM, 0.480, 0.810, and 0.650; and for rate of decline (kg/d), 0.009, 0.024, and 0.014 (av. for all three groups—0.0147). Superscripts which differ in the same experiment for the same parameter exceed the LSD.

**After correction for differences in initial level of DMI and 4% FCM, the Group I averages for all three experiments were statistically different ($P<.01$) from the Group II averages. (Least squares analysis of variance.)

cline in 4% FCM of all three experiments during the experimental period was significantly more rapid (0.017 kg/day) in Group II than in Group I.

It is concluded that cows fed a complete feed corn silage diet can be expected to consume less dry matter, produce more 4% FCM, and decline in milk production at a slower rate than cows fed the same corn silage with the concentrate added at feeding time rather than at time of ensiling.

The inclusion of adequate protein supplement (approximately 18.5% protein) avoided loss of milk production following the change to corn silage rations in which urea was either present or absent. It is yet to be shown whether or not the added protein can be added at time of ensiling with the same effect on maintaining production during the changeover period. The data also suggest that the protein was not as well utilized from the corn silage rations (approximately 14.2% protein) as it was from the 1-1-1 ration (approximately 13.4% protein). Thus, the 18.5% protein diet fed in Experiment 3 avoided the production loss when the ration was changed to corn silage.

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